APPENDIX D

NOISE

Environmental Noise Analysis

The Plaza

Bollard & Brennan Project # 2002-140

Placer County, California

Prepared For:

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INTRODUCTION

The Plaza project is located at the northeast corner of Highway 49 and Luther Road in Placer County, California. The project includes a 12,000 square-foot office building . The proposed project site plan is shown on Figure 1.

Due to the proximity of the office building site to Highway 49 to the west, Placer County staff have requested that an acoustical analysis be prepared for this project site. Specifically, the County requested that a site-specific noise study be prepared to address the compliance with the interior noise standards of the Placer County Noise Element within the office building. Bollard & Brennan, Inc. was retained by the project applicant to prepare this analysis in accordance with the County's requirement for a noise study.

FUNDAMENTALS OF NOISE

Noise is often defined simply as unwanted sound, and thus is a subjective reaction to characteristics of a physical phenomenon. Researchers have generally agreed that A-weighted sound pressure levels (sound levels) are very well correlated with community reaction to noise. The unit of sound level measurement is the decibel (dB)[1], sometimes expressed as dBA. Variations in sound levels over time are represented by statistical descriptors, and by time-weighted composite noise metrics such as the Day-Night Average Level (L_{dn}), or the Community Noise Equivalent Level (CNEL). Throughout this analysis, A-weighted sound pressure levels will be used to describe community noise unless otherwise indicated. Figure 2 provides examples of sound levels associated with common noise sources.

The decibel notation used for sound levels describes a logarithmic relationship of acoustical energy, so that sound levels cannot be added or subtracted in the conventional arithmetic manner. For example, a doubling of acoustical energy results in a change of 3 decibels (dB), which is usually considered to be barely perceptible. A 10-fold increase in acoustical energy yields a 10 decibel change, which is subjectively like a doubling of loudness.

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1 For an explanation of terms used in this report, see Appendix A.

Figure 1

Figure 2
EXAMPLES OF MAXIMUM SOUND LEVELS

NOISE SOURCE	SOUND LEVEL	SUBJECTIVE DESCRIPTION
AMPLIFIED ROCK 'N ROLL ►	120 dB	
JET TAKEOFF @ 200 FT ►		DEAFENING
	100 dB	
BUSY URBAN STREET ►		VERY LOUD
	80 dB	
JET SKI AND FREEWAY TRAFFIC @ 50 FT ►		LOUD
CONVERSATION @ 6 FT ►	60 dB	
TYPICAL OFFICE INTERIOR ►		MODERATE
SOFT RADIO MUSIC ►	40 dB	
RESIDENTIAL INTERIOR ►		FAINT
WHISPER @ 6 FT ►	20 dB	
HUMAN BREATHING ►		VERY FAINT
	0 dB	

CRITERIA FOR ACCEPTABLE NOISE EXPOSURE

Placer County General Plan Criteria:

The Placer County General Plan establishes acceptable noise level criteria for new office/professional uses affected by traffic noise sources. Table 1 provides the noise level performance criteria for projects which are affected by traffic noise sources. For projects which may be affected by transportation noise sources, such as roadway traffic, the Placer County General Plan Noise Element establishes an interior noise level criterion of 45 dB L_{dn} .

Table 1 Placer County General Plan Allowable L_{dn} Noise Levels Within Specified Zone Districts Applicable to New Projects Affected by or Including Non-Transportation Noise Sources		
Zone District or Receptor	Property Line of Receiving Use	Interior Spaces
Office/Professional	70 dB	45 dB

EVALUATION OF FUTURE TRAFFIC NOISE LEVELS AT THE PROJECT SITE

Traffic Noise Prediction Methodology:

Bollard & Brennan, Inc. employs the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA RD_77_108) for the prediction of traffic noise levels. The FHWA model is the analytical method currently favored for traffic noise prediction by most state and local agencies, including the California Department of Transportation (Caltrans). The model is based upon the CALVENO noise emission factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site.

On August, 7, 2002, Bollard and Brennan, Inc. conducted noise level measurements and concurrent counts of Highway 49 traffic on the project site. The noise level measurements were conducted to represent both first floor and second floor facades of the office building on the site. The purpose of the short-term traffic noise level measurements is to determine the accuracy of the FHWA model in describing the existing noise environment on the project site, accounting for actual travel speeds, and roadway grade and any potential shielding of traffic from topography on the site. Noise measurement results were compared to the FHWA model results by entering the observed traffic volume, speed and distance as inputs to the FHWA model. The noise level measurements were conducted at 5 feet above the ground to represent first floor office facades, and at 15 feet above the ground to represent second floor office facades. Figure 1 shows the noise measurement locations.

Instrumentation used for the measurements were Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters which were calibrated in the field before use with an LDL CA-200 acoustical calibrator. Table 2 shows the results of the traffic noise calibrations. Based upon the calibration results, the FHWA Model was found to reasonably predict traffic noise levels on the project site for first floor receivers. The FHWA Model was found to considerably under-predict traffic noise levels at the second floor office building locations by 4.3

dB. Based upon the traffic noise calibration results, no corrections will be included in the calculations of existing and future traffic noise levels at the site, for the first floor interior offices. Due to the fact that upper floor offices will be exposed to increased noise levels due to lack of excess ground attenuation and reflections of traffic noise from the street, a + 4 dB correction will be included in the prediction of existing and future upper floor interior noise levels.

Table 2
Comparison of FHWA Model To Measured Traffic Noise Levels

Vehicles/Hr.								
Site	Location	Autos	Med. Trk.	Hvy.Trk.	Posted Speed (mph)	Dist. (Feet)	Measured L_{eq}, dB	Modeled L_{eq}, dB*
Highway 49								
1	First floor	4080	66	24	50	150	68.6	67.2
2	Second floor	3942	84	48	50	150	71.8	67.5

* Acoustically "soft" site assumed.
Distances from roadways are from the centerline of the roadway.

ANALYSIS

Existing And Future Traffic Noise Levels:

To determine the existing traffic noise levels on the project site, Bollard & Brennan, Inc. used traffic data provided by the California Department of Transportation (Caltrans). To be conservative, this analysis assumed that future traffic volumes could increase by up to 100%. Table 3 provides the inputs to the FHWA Traffic Noise Prediction Model. Based upon the analysis the predicted existing and future traffic noise level on the project site are shown in Table 4.

Table 3
Highway 49 FHWA Model Assumptions

ADT		Traffic Distribution		Truck Mix		Speed (mph)
		Day %	Night %	Medium	Heavy	
Existing	Future*					
46000	92000	85	15	1.8	1.3	50

*Future traffic volume obtained by doubling existing volume.

Table 4
Predicted Highway 49 Traffic Noise Levels

Distance to Noise Contours		Predicted L_{dn}	
60 dB L_{dn}	65 dB L_{dn}	Nearest First Floor Facade	Nearest Upper Floor* Facade
Existing			
509 feet	236 feet	69 dB	73 dB
Future			
809 feet	375 feet	72 dB	76 dB

* Accounts for a +4 dB correction to the FHWA Model based upon on-site calibration results. Distances to contours are from the roadway centerline.

Predicted Interior Noise Levels:

To judge the potential for achieving an interior noise level of 45 dB L_{dn}, it is necessary to determine the noise reduction provided by the building facade. This may be calculated by assuming a generalized A-weighted noise frequency spectrum for traffic noise. The composite transmission loss and resulting noise level in the receiving room must be determined, then correcting for room absorption, the overall noise level in the room is calculated.

This process is illustrated by Appendix D for the facades of the most affected units facing Highway 49. Floor plans were not available at the time of this analysis. Typical floor plans and construction details for an office building were used for this analysis. The proposed exterior wall construction of the units is assumed to consist of a minimum 2x4-inch studs with a wood siding and under layer of wood sheathing, R-19 insulation in the stud cavities, and gypsum board on the interior walls. Window glazing and assemblies were assumed to be dual glazed and are mounted in low-infiltration rate frames. It was also assumed that no major flanking paths such as non-baffled ducts or vents were present. Table 5 shows the results of the interior traffic noise calculations.

Table 5
Calculated Office Building Interior Noise Levels

Office Building Unit	Predicted L_{dn}		Achieves Placer County 45 dB L_{dn} interior noise level criterion
	Exterior	Interior[1]	
Existing			
First Floor[2]	69 dB	40 dB	Yes
Upper Floors[2]	73 dB	44 dB	Yes
Future			
First Floor[2]	72 dB	43 dB	Yes
Upper Floors[2]	76 dB	47 dB	No
Upper Floors w/ STC-30 windows[3]	76 dB	43 dB	Yes

[1] The noise level calculations account for the noise exposure of all affected facades, and include a 3 dB safety factor to account for variations in materials.
[2] Standard construction for office buildings.
[3] Standard wall construction with STC-30 windows.

Based upon the analysis shown in Table 5, upper floor units with standard construction details will be exposed to future interior noise levels of 47 dB L_{dn}. In order to achieve the Placer County interior noise level criterion of 45 dB L_{dn}, windows of upper floor offices, facing Highway 49, should have a Sound Transmission Classification (STC) rating of at least 30.

Mechanical ventilation would be required to allow occupants to close windows and doors, while providing adequate air exchange.

CONCLUSIONS

Future interior noise levels could exceed the interior noise level criterion of 45 dB Ldn at second floor office buildings. As a means of assuring that interior noise levels will comply with the 45 dB Ldn interior noise level criterion, windows of upper floor offices, facing Highway 49, should have a Sound Transmission Classification (STC) rating of at least 30.

These conclusions are based on the traffic assumptions provided by California Department of Transportation (Caltrans) published traffic volumes, and on noise reduction data for standard office buildings and for typical STC rated window data. Bollard & Brennan, Inc. is not responsible for degradation in acoustic performance of the residential construction due to poor construction practices, failure to comply with applicable building code requirements, or for failure to adhere to the minimum building practices cited in this report.

Appendix A

Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
Ldn	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
Loudness	A subjective term for the sensation of the magnitude of sound.
Masking	The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound.
Noise	Unwanted sound.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
RT_{60}	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches.

Appendix B

FHWA Traffic Noise Prediciton Model (FHWA-RD-77-108) Calibration Worksheet

Project Information	Job Number:	2002-140
	Project Name:	Plaza Project
	Roadway Tested:	Highway 49
	Test Location:	See Figure 1
	Test Date:	August 7, 2002
Weather Conditions	Temperature (Fahrenheit):	85
	Relative Humidity:	Moderate
	Wind Speed and Direction:	0-3 west
	Cloud Cover:	Clear
Sound Level Meter	Sound Level Meter:	LDL Model 820
	Calibrator:	LDL Model CA200
	Meter Calibrated:	Immediately before and after test
	Meter Settings:	A-weighted, slow response
Microphone	Microphone Location:	On Project Site
	Distance to Centerline (feet):	150
	Microphone Height:	15.5 feet above ground
	Intervening Ground:	soft
	Elevation Relative to Road (feet):	17.5
Roadway Condition	Pavement Type	Asphalt
	Pavement Condition:	Good
	Number of Lanes:	6- Three each direction
	Posted Maximum Speed (mph):	50
Test Parameters	Test Time:	01:43 PM
	Test Duration (minutes):	10
	Observed Number Automobiles:	657
	Observed Number Medium Trucks:	14
	Observed Number Heavy Trucks:	8
	Observed Average Speed (mph):	50
Model Calibration	Measured Average Level (Leq):	71.8
	Level Predicted by FHWA Model:	67.5
	Difference:	***-4.3 dB***

Conclusions

Appendix C

FHWA Traffic Noise Prediciton Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information

Job Number: 2002-140
Project Name: Plaza
Roadway Name: Highway 49

Traffic Data

Year: Existing
Average Daily Traffic Volume: 46,000
Percent Daytime Traffic: 85
Percent Nighttime Traffic: 15
Percent Medium Trucks (2 axle): 1.8
Percent Heavy Trucks (3+ axle): 1.3
Assumed Vehicle Speed (mph): 50
Intervening Ground Type: **Soft**
Calibration Offset (dB): 0

Traffic Noise Levels

			Ldn, dB			
Location		Distance	Autos	Medium Trucks	Heavy Trucks	Total
1	building facade	130	68	58	61	69

Noise Contours

Ldn Contour	Distance from Centerline, Feet
75	51
70	110
65	236
60	509

Notes

Appendix C

FHWA Traffic Noise Prediciton Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information

Job Number: 2002-140
Project Name: Plaza
Roadway Name: Highway 49

Traffic Data

Year: Future
Average Daily Traffic Volume: 92,000
Percent Daytime Traffic: 85
Percent Nighttime Traffic: 15
Percent Medium Trucks (2 axle): 1.8
Percent Heavy Trucks (3+ axle): 1.3
Assumed Vehicle Speed (mph): 50
Intervening Ground Type: **Soft**
Calibration Offset (dB): 0

Traffic Noise Levels

			Ldn, dB			
Location		Distance	Autos	Medium Trucks	Heavy Trucks	Total
1	building facade	130	71	61	64	72

Noise Contours

Ldn Contour	Distance from Centerline, Feet
75	81
70	174
65	375
60	809

Notes Future traffic volumes were obtained from doubling existing traffic volumes.

Appendix D

Facade Noise Reduction

Plaza - Standard Office - Typical Dual Glaze Window - Existing 1st floors

August 28, 2002

A-weighted Sound Pressure Level (dB) at One-Third Octave Band Center Frequency (Hz)

	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
Exterior Noise Level	50.3	52.3	52.4	54.5	55.1	56.1	56.0	59.4	61.6	61.0	60.1	58.2	56.1	54.3	49.3	44.9
TL: Wall(s)	25.0	30.0	42.0	41.0	44.0	43.0	45.0	45.0	46.0	45.0	46.0	48.0	50.0	50.0	50.0	55.0
TL: Window(s)	23.0	21.0	22.0	22.0	20.0	17.0	22.0	26.0	28.0	31.0	33.0	34.0	35.0	36.0	36.0	31.0
TL: Door(s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TL: Miscellaneous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Room Absorption	-3.4	-3.4	-0.8	-0.8	-0.8	-0.2	-0.2	-0.2	0.6	0.6	0.6	-1.1	-1.1	-1.1	-2.2	-2.2
TL: Composite	24.5	26.2	28.8	28.7	26.9	23.9	28.9	32.7	34.7	37.3	39.2	40.3	41.4	42.3	42.3	37.9
Correction Factor	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Interior Noise Level	25.4	25.7	25.8	27.9	30.4	35.0	29.9	29.4	30.5	27.2	24.5	19.8	16.6	13.9	7.8	7.8

Summary:	dBA
Correction Factor	3.0
Exterior Noise Level	69.0
Interior Noise Level	40.0
Overall Noise Reduction	29.0

Appendix D
Facade Noise Reduction
Plaza - Standard Office - Typical Dual Glaze Window - Existing 2nd/3rd floors
August 28, 2002

A-weighted Sound Pressure Level (dB) at One-Third Octave Band Center Frequency (Hz)

	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
Exterior Noise Level	54.3	56.3	56.4	58.5	59.1	60.1	60.0	63.4	65.6	65.0	64.1	62.2	60.1	58.3	53.3	48.9
TL: Wall(s)	25.0	30.0	42.0	41.0	44.0	43.0	45.0	45.0	46.0	45.0	46.0	48.0	50.0	50.0	50.0	55.0
TL: Window(s)	23.0	21.0	22.0	22.0	20.0	17.0	22.0	26.0	28.0	31.0	33.0	34.0	35.0	36.0	36.0	31.0
TL: Door(s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TL: Miscellaneous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Room Absorption	-3.4	-3.4	-0.8	-0.8	-0.8	-0.2	-0.2	-0.2	0.6	0.6	0.6	-1.1	-1.1	-1.1	-2.2	-2.2
TL: Composite	24.5	26.2	28.8	28.7	26.9	23.9	28.9	32.7	34.7	37.3	39.2	40.3	41.4	42.3	42.3	37.9
Correction Factor	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Interior Noise Level	29.4	29.7	29.8	31.9	34.4	39.0	33.9	33.4	34.5	31.2	28.5	23.8	20.6	17.9	11.8	11.8

Summary:	dBA
Correction Factor	3.0
Exterior Noise Level	73.0
Interior Noise Level	44.0
Overall Noise Reduction	29.0

Appendix D

Facade Noise Reduction

Plaza - Standard Office - Typical Dual Glaze Window - Future 1st floors

August 28, 2002

A-weighted Sound Pressure Level (dB) at One-Third Octave Band Center Frequency (Hz)

	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
Exterior Noise Level	53.3	55.3	55.4	57.5	58.1	59.1	59.0	62.4	64.6	64.0	63.1	61.2	59.1	57.3	52.3	47.9
TL Wall(s)	25.0	30.0	42.0	41.0	44.0	43.0	45.0	45.0	46.0	45.0	46.0	48.0	50.0	50.0	50.0	55.0
TL Window(s)	23.0	21.0	22.0	22.0	20.0	17.0	22.0	26.0	28.0	31.0	33.0	34.0	35.0	36.0	36.0	31.0
TL: Door(s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TL: Miscellaneous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Room Absorption	-3.4	-3.4	-0.8	-0.8	-0.8	-0.2	-0.2	-0.2	0.6	0.6	0.6	-1.1	-1.1	-1.1	-2.2	-2.2
TL: Composite	24.5	26.2	28.8	28.7	26.9	23.9	28.9	32.7	34.7	37.3	39.2	40.3	41.4	42.3	42.3	37.9
Correction Factor	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Interior Noise Level	28.4	28.7	28.8	30.9	33.4	38.0	32.9	32.4	33.5	30.2	27.5	22.8	19.6	16.9	10.8	10.8

Summary:	dBA
Correction Factor	3.0
Exterior Noise Level	72.0
Interior Noise Level	43.0
Overall Noise Reduction	29.0

Appendix D

Facade Noise Reduction

Plaza - Standard Office - Typical Dual Glaze Window - Future 2nd/3rd floors

August 28, 2002

A-weighted Sound Pressure Level (dB) at One-Third Octave Band Center Frequency (Hz)

	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
Exterior Noise Level	57.3	59.3	59.4	61.5	62.1	63.1	63.0	66.4	68.6	68.0	67.1	65.2	63.1	61.3	56.3	51.9
TL: Wall(s)	25.0	30.0	42.0	41.0	44.0	43.0	45.0	45.0	46.0	45.0	46.0	48.0	50.0	50.0	50.0	55.0
TL: Window(s)	23.0	21.0	22.0	22.0	20.0	17.0	22.0	26.0	28.0	31.0	33.0	34.0	35.0	36.0	36.0	31.0
TL: Door(s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TL: Miscellaneous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Room Absorption	-3.4	-3.4	-0.8	-0.8	-0.8	-0.2	-0.2	-0.2	0.6	0.6	0.6	-1.1	-1.1	-1.1	-2.2	-2.2
TL: Composite	24.5	26.2	28.8	28.7	26.9	23.9	28.9	32.7	34.7	37.3	39.2	40.3	41.4	42.3	42.3	37.9
Correction Factor	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Interior Noise Level	32.4	32.7	32.8	34.9	37.4	42.0	36.9	36.4	37.5	34.2	31.5	26.8	23.6	20.9	14.8	14.8

Summary:	dBA
Correction Factor	3.0
Exterior Noise Level	76.0
Interior Noise Level	47.0
Overall Noise Reduction	29.0

Appendix D

Facade Noise Reduction

Plaza - Standard Office - STC 30 Window - Future 2nd/3rd Floor

August 28, 2002

A-weighted Sound Pressure Level (dB) at One-Third Octave Band Center Frequency (Hz)

	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
Exterior Noise Level	57.3	59.3	59.4	61.5	62.1	63.1	63.0	66.4	68.6	68.0	67.1	65.2	63.1	61.3	56.3	51.9
TL: Wall(s)	25.0	30.0	42.0	41.0	44.0	43.0	45.0	45.0	46.0	45.0	46.0	48.0	50.0	50.0	50.0	55.0
TL: Window(s)	23.0	27.0	25.0	23.0	28.0	26.0	29.0	30.0	31.0	32.0	32.0	32.0	32.0	31.0	31.0	31.0
TL: Door(s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TL: Miscellaneous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Room Absorption	-3.4	-3.4	-0.8	-0.8	-0.8	-0.2	-0.2	-0.2	0.6	0.6	0.6	-1.1	-1.1	-1.1	-2.2	-2.2
TL: Composite	24.5	29.2	31.6	29.7	34.5	32.6	35.5	36.4	37.4	38.2	38.3	38.5	38.7	37.7	37.7	37.9
Correction Factor	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Interior Noise Level	32.4	29.7	30.0	34.0	29.7	33.3	30.2	32.7	34.7	33.4	32.3	28.6	26.3	25.5	19.4	14.8

Summary:	dBA
Correction Factor	3.0
Exterior Noise Level	76.0
Interior Noise Level	43.1
Overall Noise Reduction	32.8

Environmental Noise Assessment

The Plaza Commercial Development EIR

Placer County, California

Bollard & Brennan Job # 2003-237

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INTRODUCTION

This report examines the existing noise environment and potential noise-related impacts, which may occur as a part of the Plaza Commercial Development.

The Plaza Commercial Development project site is located in the northeast corner of the Highway 49 and Luther Road intersection in Placer County, California. The proposed project consists of a mixed-use commercial shopping center comprised of a total of 79,000 square feet of building space. Figure 1 shows the proposed project site plan.

Noise sources due to and upon the proposed project include roadway traffic, stationary noise sources associated with the commercial uses, and parking lot activities.

SETTING

Acoustical Terminology

Noise is often defined simply as unwanted sound, and thus is a subjective reaction to characteristics of a physical phenomenon. Researchers for many years have grappled with the problem of translating objective measurements of sound into directly correlated measures of public reaction to noise. The descriptors of community noise in current use represent simplified, practical measurement tools to gauge community response. Table 1 provides examples of maximum noise levels associated with common noise sources. Appendix A provides definitions of noise descriptors

A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (Leq), which is the sound level corresponding to a steady-state A-weighted sound level in decibels (dB) containing the same total energy as a time-varying signal over a given time period (usually one hour). The Leq is the foundation of the composite noise descriptors such as Ldn and CNEL, and shows very good correlation with community response to noise.

Two composite noise descriptors are in common use today: Ldn and CNEL. The Ldn (Day-Night Average Level) is based upon the average hourly Leq over a 24-hour day, with a +10 decibel weighting applied to nighttime (10:00 p.m. to 7:00 a.m.) Leq values. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were subjectively twice as loud as daytime exposures. The CNEL (Community Noise Equivalent Level), like Ldn, is based upon the weighted average hourly Leq over a 24-hour day, except that an additional +4.77 decibel penalty is applied to evening (7:00 p.m. to 10:00 p.m.) hourly Leq values. Measured Ldn and CNEL values are generally within 1 dB of one another. The CNEL was developed for the California Airport Noise Regulations, and is normally applied to airport/aircraft noise assessments. The Ldn descriptor is a simplification of the CNEL concept, but the two will usually agree, for a given situation, within 1 dB. Like the Leq, these descriptors are also averages and tend to disguise short-term variations in the noise environment. Because they presume increased evening or nighttime sensitivity, these descriptors are best applied as criteria for land uses where nighttime noise exposures are critical to the acceptability of the noise environment, such as residential developments.

The State Office of Planning and Research Noise Element Guidelines require that major noise sources be identified and quantified by preparing generalized noise contours for current and projected conditions. Significant noise sources include traffic on major roadways and highways, and representative industrial activities and fixed noise sources.

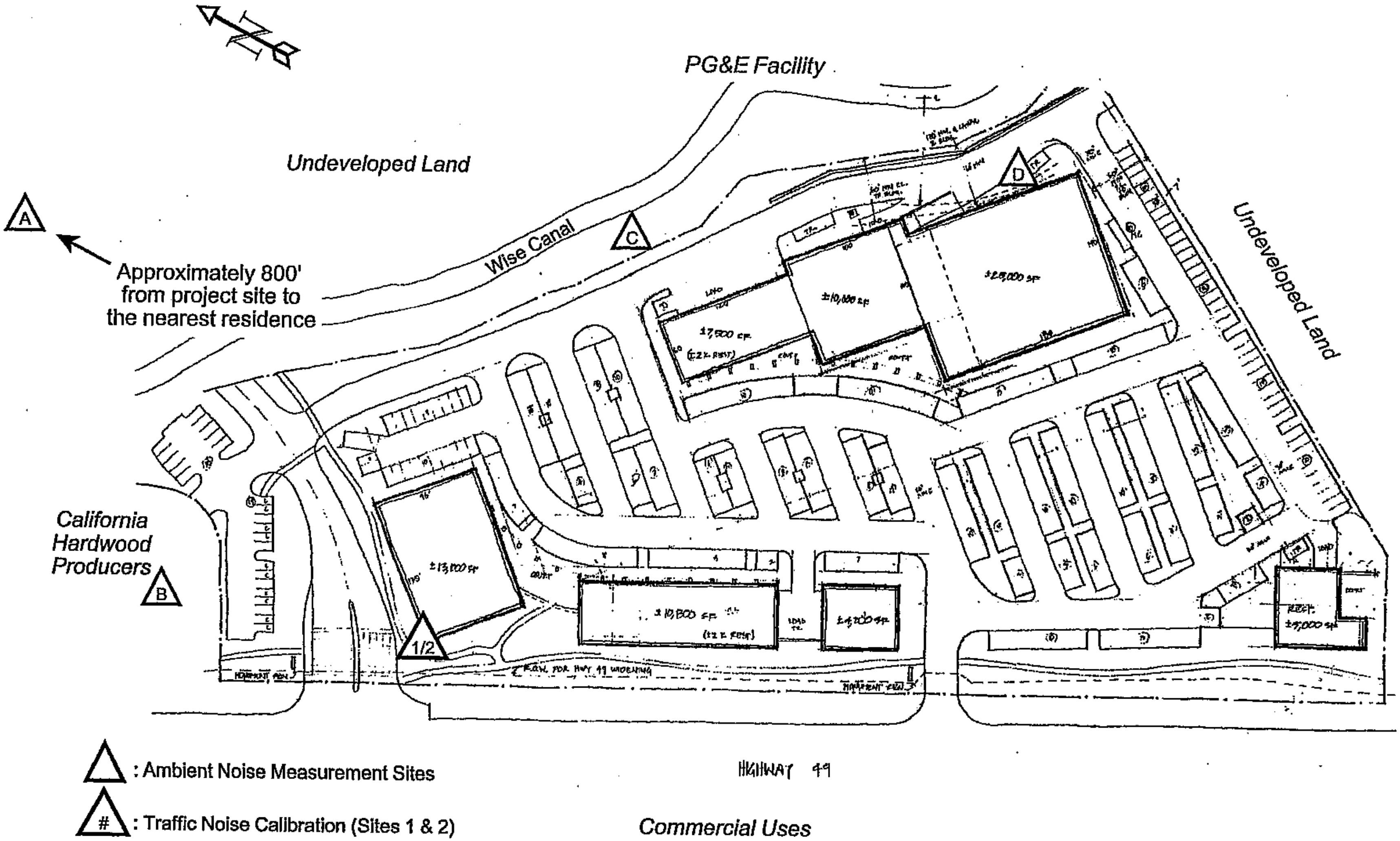
Noise modeling techniques and noise measurements were used to develop generalized Ldn/CNEL or Leq noise contours for the major roadways and fixed noise sources in the Plaza Commercial Development project study area for existing conditions.

Modeling methods have been developed for a number of environmental noise sources including roadways, railroad line operations, railroad yard operations and industrial plants. Such methods produce reliable results as long as data inputs and assumptions are valid. The modeling methods used in this report closely follow recommendations made by the State Office of Noise Control, and were supplemented where appropriate by field-measured noise level data to account for local conditions. The noise exposure contours are based upon annual average conditions. Because local topography, vegetation or intervening structures may significantly affect noise exposure at a particular location, the noise contours should not be considered site-specific.

Table 1
Typical A-Weighted Maximum Sound Levels of Common Noise Sources

Decibels	Description
130	Threshold of pain
120	Jet aircraft take-off at 100 feet
110	Riveting machine at operators position
100	Shot-gun at 200 feet
90	Bulldozer at 50 feet
80	Diesel locomotive at 300 feet
70	Commercial jet aircraft interior during flight
60	Normal conversation speech at 5-10 feet
50	Open office background level
40	Background level within a residence
30	soft whisper at 2 feet
20	Interior of recording studio

Figure 1
The Plaza Commercial Development
Placer County, California



Bollard & Brennan, Inc.

Criteria For Acceptable Noise Exposure:

<u>Placer County General Plan</u>

The Placer County General Plan Policies pertaining to noise are designed to protect County residents from the harmful and annoying effects of exposure to excessive noise. Those policies that would be applicable to this project are reproduced below:

1. The County shall not allow development of new noise-sensitive uses where the noise level due to non-transportation noise sources will exceed the noise level standards of Table 2 (Table 9-1 of the Placer County General Plan Noise Element) as measured immediately within the property line of the new development, unless effective noise mitigation measures have been incorporated into the development design to achieve the standards specified in Table 2.

2. The County shall require that noise created by new non-transportation noise sources be mitigated so as not to exceed the noise level standards of Table 2 (Table 9-1 of the Placer County General Plan) as measured immediately within the property line of lands designated for noise-sensitive uses.

3. The feasibility of proposed projects with respect to existing and future transportation noise levels shall be evaluated by comparison to Table 3 (Table 9-3 of the Placer County General Plan).

4. Noise created by new transportation noise sources, including roadway improvement projects, shall be mitigated so as not to exceed the levels specified in Table 3 (Table 9-3 of the Placer County General Plan) at the outdoor activity areas or interior spaces of existing noise-sensitive land uses.

5. The county shall implement one or more of the following mitigation measures where existing noise levels significantly impact existing noise-sensitive land uses, or where the cumulative increase in noise levels resulting from new development significantly impacts noise-sensitive land uses:
    a. Rerouting traffic onto streets that have available traffic capacity and that do not adjoin noise-sensitive land uses;
    b. Lowering speed limits, if feasible and practical;
    c. Programs to pay for noise mitigation such as low cost loans to owners of noise-impacted property or establishment of developer fees;
    d. Acoustical treatment of buildings; or
    e. Construction of noise barriers.

6. Where noise mitigation measures are required to achieve the standards of Tables 2 or 3, the emphasis of such measures shall be placed upon site planning and project design. The use of noise barriers shall be considered as a means of achieving the noise standards only after all other practical design-related noise mitigation measures have been incorporated into the project.

Table 2
(Table 9-1 of the Placer County General Plan)
Allowable Ldn Noise Levels Within Specified Zone Districts
Applicable to New Projects Affected by or Including Non-Transportation Noise Sources

Zone District of Receptor	Property Line of Receiving Use	Interior Space
Residential adjacent to industrial	60 dBA	45 dBA
Other Residential	50 dBA	45 dBA
Office/Professional	70 dBA	45 dBA
Neighborhood Commercial	70 dBA	45 dBA

Notes for Table 2:

1. Except where noted otherwise, noise exposures will be those that occur at the property line of the receiving use.
2. Interior spaces are defined as any locations where some degree of noise-sensitivity exists. Examples include all habitable rooms of residences, and areas where communication and speech intelligibility are essential, such as classrooms and offices.

Table 3
(Table 9-3 of the Placer County General Plan)
Maximum Allowable Noise Exposure (Ldn)
Transportation Noise Sources

Land Use	Outdoor Activity Areas (a)	Interior Spaces	
	Ldn/CNEL, dB	Ldn/CNEL, dB	Leq, dB (b)
Residential	60 (c)	45	--
Transient Lodging	60 (c)	45	--
Hospitals, Nursing Homes	60 (c)	45	--
Theaters, Auditoriums	--	--	35
Churches, Meeting Halls	60 (c)	--	40
Office Buildings	--	--	45
Schools, Libraries, Museums	--	--	45

(a) Where the location of outdoor activity areas is unknown, the exterior noise level standard shall be applied to the property line of the receiving land use.
(b) As determined for a typical worst-case hour during periods of use.
(c) Where it is not possible to reduce noise in outdoor activity areas to 60 Ldn/CNEL or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB Ldn/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table.

Auburn-Bowman Community Plan

The proposed project site is also located within the Auburn-Bowman Community Plan area. Noise-related goals of the Auburn-Bowman Community Plan are as follows:

a. To protect community plan area residents from the harmful and annoying effects of exposure to excessive noise.

b. To preserve the rural noise environment of the community plan area and surrounding areas.

The following policies are contained within the Auburn-Bowman Community Plan:

1. Noise created by new non-transportation noise sources shall be mitigated so as not to exceed the noise level standards of Table 4 (Table14 of the Auburn Bowman Community Plan), as measured immediately within the property line of lands designated for noise-sensitive uses.

2. Where proposed non-residential land uses are likely to produce noise levels exceeding the performance standards of Table 4 (Table14 of the Auburn Bowman Community Plan) at existing or planned noise-sensitive uses, an acoustical analysis shall be required as part of the environmental review process so that noise mitigation may be included in the project design.

Note: For the purpose of the Noise Element, transportation noise sources are defined as traffic on public roadways, railroad line operations, and aircraft in flight. Control of noise from these sources is preempted by Federal and State regulations. Other noise sources are presumed to be subject to local regulations, such as a noise control ordinance. Non-transportation noise sources may include industrial operations, outdoor recreation facilities, HVAC units, loading docks, etc.

3. The feasibility of proposed projects with respect to existing and future transportation noise levels shall be evaluated by comparison to Table 5 (Table 16 of the Auburn Bowman Community Plan).

4. New development of noise-sensitive land uses will not be permitted in areas exposed to existing or projected levels of noise from transportation noise sources which exceed the levels specified in Table 5 (Table 16 of the Auburn Bowman Community Plan), unless the project design includes effective mitigation measures to reduce noise in outdoor activity areas and interior spaces to the level specified in Table 5 (Table 16 of the Auburn Bowman Community Plan).

5. Noise created by new transportation noise sources, including roadway improvement projects, shall be mitigated so as not to exceed the levels as specified in Table 5 (Table 16 of the Auburn Bowman Community Plan) at outdoor activity areas or interior spaces of existing noise-sensitive land uses in either the incorporated or unincorporated areas.

6. Where noise mitigation measures are required to achieve the standards of Table 4 and 5 (Tables 14 and 16 of the Auburn Bowman Community Plan), the emphasis of such measures shall be placed upon site planning and project design. The use of noise barriers shall be considered a means of achieving

the noise standards only after all other practical design-related noise mitigation measures have been integrated into the project.

Table 4
(Table 14 of the Auburn-Bowman Community Plan)
Noise Level Performance Standards
For Projects Affected by or Including Non-Transportation Noise Sources

Noise Level Descriptor	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly L_{eq}, dB	50	45
Maximum Level, dB	70	65

Each of the noise levels specified above shall be lowered by five dB for simple tone noises, noises consisting primarily or speech or music, or for recurring impulsive noises. These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwelling).

Table 5
(Table 16 of the Auburn Bowman Community Plan)
Maximum Allowable Noise Exposure
Transportation Noise Sources

Land Use	Outdoor Activity Areas[1]	Interior Spaces	
	L_{dn}/CNEL, dB	*L_{dn}/CNEL, dB*	*L_{eq}, dB[2]*
Residential	60[3]	45	--
Transient Lodging	60[3]	45	--
Hospitals, Nursing Homes	60[3]	45	--
Theaters, Auditoriums, Music Halls	--	--	35
Churches, Meeting Halls	60[3]	--	40
Office Buildings	60[3]	--	45
Schools, Libraries, Museums	--	--	45
Playgrounds, Neighborhood Parks	70	--	--

1. Where the location of outdoor activity areas in unknown, the exterior noise level standard shall be applied to the property line of the receiving land use.
2. As determined for a typical worst-case hour during periods of use.
3. Where it is not possible to reduce noise in outdoor activity areas to 60 dB L_{dn}/CNEL or less using a practical application of the best-available noise reduction measures, an exterior noise level of up to 65 dB L_{dn}/CNEL may be allowed provided that available exterior noise level reduction measures have been implemented and interior noise levels are in compliance with this table. For properties affected by transportation noise from I-80 or railroad tracks, this maximum level shall be 70 dB L_{dn}/CNEL, provided that interior levels are in compliance with this table.

Subjective Reaction to Changes in Noise Levels

Another means of determining a potential noise impact is to assess a person's reaction to changes in noise levels due to a project. Table 6 is commonly used to show expected public reaction to changes in environmental noise levels. This table was developed on the basis of test subjects' reactions to changes in the levels of steady-state pure tones or broad-band noise and to changes in levels of a given noise source. It is probably most applicable to noise levels in the range of 50 to 70 dBA, as this is the usual range of voice and interior noise levels.

Table 6
Subjective Reaction To Changes In Noise Levels of Similar Sources

Change in Level, dBA	Subjective Reaction	Factor Change in Acoustical Energy
1	Imperceptible (Except for Tones)	1.3
3	Just Barely Perceptible	2.0
6	Clearly Noticeable	4.0
10	About Twice (or Half) as Loud	10.0

Source: Architectural Acoustics, M. David Egan, 1988.

Standards of Significance

Criteria for determining the significance of noise impacts were developed based on information contained in the California Environmental Quality Act Guidelines (State CEQA Guidelines). According to those guidelines, a project may have a significant effect on the environment if it will satisfy the following conditions:

a. Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or community plan.

b. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.

c. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

For this project, noise impacts are considered significant if the proposed project would expose individuals to noise levels in excess of the Placer County Noise Element or Auburn-Bowman Community Plan standards shown in Tables 2, 3, 4, and 5, or if the project results in a permanent increase in noise levels in excess of 3 dB.

Existing Roadway Noise

The Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA-RD-77-108) was used to develop Ldn contours for all major roadways. The FHWA Model is the analytical method presently favored for traffic noise prediction by most state and local agencies, including Caltrans. The current version of the model is based upon the CALVENO noise emission factors for automobiles, medium trucks, and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver and the acoustical characteristics of the site. The FHWA Model predicts hourly Leq values for free-flowing traffic conditions, and is generally considered to be accurate within 1.5 dB. To predict Ldn values, it is necessary to determine the hourly distribution of traffic for a typical 24-hour day and to adjust the traffic volume input data to yield an equivalent hourly traffic volume.

On August, 7, 2002, Bollard and Brennan, Inc. conducted noise level measurements and concurrent counts of Highway 49 traffic on the project site. The purpose of the short-term traffic noise level measurements is to determine the accuracy of the FHWA model in describing the existing noise environment on the project site, accounting for actual travel speeds, and roadway grade and any potential shielding of traffic from topography on the site. Noise measurement results were compared to the FHWA model results by entering the observed traffic volume, speed and distance as inputs to the FHWA model. The noise level measurements were conducted at 5 feet above the ground to represent first floor office facades, and at 15 feet above the ground to represent second floor office facades. Figure 1 shows the traffic noise measurement site.

Instrumentation used for the measurements were Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters, which were calibrated in the field before use with an LDL CA-200 acoustical calibrator. Table 7 shows the results of the traffic noise calibrations.

Based upon the calibration results, the FHWA Model was found to reasonably predict traffic noise levels for proposed first floor receivers on the project site. The FHWA Model was found to considerably under-predict traffic noise levels at the second floor office building locations by 4.3 dB. Upper floor offices will be exposed to increased traffic noise levels due to a lack of excess ground attenuation and reflections of traffic noise from the street. For this reason, a + 4 dB correction will be included in the prediction of existing and future upper floor interior noise levels. Therefore, no correction to the model is considered necessary in the prediction of traffic noise levels at first or upper floor offices areas.

Table 7 Comparison of FHWA Model To Measured Traffic Noise Levels								
Vehicles/Hr.					Posted Speed (mph)	Dist. (Feet)	Measured L_{eq}, dB	Modeled L_{eq}, dB*
Site	Location	Autos	Med. Trk.	Hvy.Trk.				
Highway 49								
1	First floor	4080	66	24	50	150	68.6	67.2
2	Second floor	3942	84	48	50	150	71.8	67.5

* Acoustically "soft" site assumed.
Distances from roadways are from the centerline of the roadway.

Traffic data representing annual average traffic volumes for existing conditions were obtained from the traffic study prepared for this project by Omni-Means, Ltd. Using the FHWA methodology, traffic noise levels as defined by Ldn were calculated for existing traffic volumes. Distances from the centerlines of selected roadways to the existing 55 dB, 60 dB, and 65 dB Ldn contours are summarized in Table 8. Appendix C contains the Highway Traffic Noise Prediction Model input data.

Table 8 Predicted Existing Traffic Noise Level Data				
		Distances to Traffic Noise Contours (ft.)		
Segment	Description	55 dB	60 dB	65 dB
State Route 49				
1	South of Kemper Road	1088	505	234
2	North of Luther Road	1090	506	235
3	South of Luther Road	1053	489	227
Luther Road				
4	State Route 49 to Canal Street	185	86	40
5	Canal Street to Wesley Lane	163	76	35
6	East of Wesley Lane	154	72	33
Canal Street				
7	North of Luther Road	42	20	9

Existing Ambient Noise Levels in the Vicinity of the Project Site

A community noise survey was conducted to document noise exposure in the vicinity of the Plaza Commercial Development project site.

Short-term noise monitoring was conducted at four sites on January 30, 2003. These sites were selected to represent the general noise environment at the project site as well as at the nearest noise sensitive land uses. The data collected included the Leq, the maximum level during the measurement period (Lmax), and other statistical descriptors. The results of this monitoring are summarized in Table 9. Figure 1 shows the noise measurement locations.

Instrumentation used for the measurements were Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters, which were calibrated in the field before use with an LDL CA-200 acoustical calibrator.

The community noise survey results indicate that measured background noise levels in the immediate project vicinity are in the range of approximately 55 dB Leq to 59 dB Leq. Traffic on Hwy 49 is the primary source of background noise at the project site.

The Leq values in Table 9 represent the average measured noise levels during the sample periods. The Leq values were the basis of the estimated Ldn values. The L_{max} values show the maximum noise levels observed during the sample periods. The L50 values represent the noise levels exceeded 50 percent of the time during the sample period.

Table 9
Summary of Measured Noise Levels and Estimated Day/Night Average Levels (Ldn)

Site	Location	Sound Level, dB		
		Daytime Leq	Daytime L50	Daytime L_{max}
A	Nearest residence (~800') North of Site	46.4	44.4	60.3
B	California Hardwood Producers Office	59.2	58.4	67.1
C	Eastern Boundary of site	55.5	55.1	63.3
D	Southeast Corner of Site	55.4	54.8	60.5

IMPACTS

Noise impacts associated with the project are expected to be due to increased traffic on local roadways, and on conflicts between commercial activities on the project site and existing residences in the project vicinity.

Traffic Noise

To describe the Existing + Project traffic noise levels due to and upon the project site, the Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA RD-77-108) was used. The model is based upon the Calveno reference noise factors for automobiles, medium trucks and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The FHWA model was developed to predict hourly Leq values for free-flowing traffic conditions. To predict traffic noise levels in terms of Ldn, it is necessary to adjust the input volume to account for the day/night distribution of traffic.

Traffic volumes for the Existing + Project conditions were provided by the traffic study performed for this project by Omni-Means Ltd. A complete listing of the FHWA Model input data is provided in Appendix C. Table 10 contains the predicted Existing + Project traffic noise levels.

Table 10 also shows the expected change in traffic noise levels due to the project, when compared to the predicted existing traffic noise levels. The data indicate that the changes in traffic noise levels ranged between 0 dB Ldn to 0.3 dB Ldn.

Table 10
Predicted Existing + Project Traffic Noise Level Data

Segment	Description	Ldn , dB @ 100'	Increase in Noise Levels, dB	Distances to Traffic Noise Contours (ft.)	
				60 dB	65 dB
State Route 49					
1	South of Kemper Road	70.8	0.3	523	243
2	North of Luther Road	70.8	0.2	524	243
3	South of Luther Road	70.5	0.2	504	234
Luther Road					
4	State Route 49 to Canal Street	59.3	0.3	89	41
5	Canal Street to Wesley Lane	58.5	0.3	79	37
6	East of Wesley Lane	58.1	0.3	75	35
Canal Street					
7	North of Luther Road	49.4	0	20	9

Tables 11 and 12 contain the predicted Interm (Year 2010) and Interm (Year 2010) + Project traffic noise levels. Once again the FHWA model was used in predicting these traffic noise levels. Table 12 shows the expected increases in traffic noise levels due to the project. The data indicate that Interm (Year 2010) traffic noise levels increases will range between 0 dB Ldn and 0.2 dB Ldn.

Table 11 Predicted Interm (Year 2010) Traffic Noise Level Data				
Segment	Description	Ldn, dB @ 100’	Distance to Traffic Noise Contours (ft.)	
			60 dB	65 dB
Hwy 49				
1	South of Kemper Road	71.6	597	277
2	North of Luther Road	71.7	601	279
3	South of Luther Road	71.4	574	267
Luther Road				
4	State Route 49 to Canal Street	60.4	106	49
5	Canal Street to Wesley Lane	59.7	95	44
6	East of Wesley Lane	59.6	94	44
Canal Street				
7	North of Luther Road	51.0	25	12

Table 12 Predicted Interm (Year 2010) + Project Traffic Noise Level Data					
Segment	Description	Ldn , dB @ 100’	Increase in Noise Levels, dB	Distances to Traffic Noise Contours (ft.)	
				60 dB	65 dB
State Route 49					
1	South of Kemper Road	71.8	0.2	614	285
2	North of Luther Road	71.9	0.2	618	287
3	South of Luther Road	71.5	0.1	588	273
Luther Road					
4	State Route 49 to Canal Street	60.5	0.1	109	50
5	Canal Street to Wesley Lane	59.9	0.2	98	46
6	East of Wesley Lane	59.8	0.2	98	45
Canal Street					
7	North of Luther Road	51.0	0	25	12

Tables 13 and 14 show the predicted Cumulative (Year 2020) and Cumulative (Year 2020) + Project traffic noise levels. Table 14 also shows the expected increase in traffic noise levels due to the project. Based upon Table 14, the Cumulative (Year 2020), changes in traffic noise levels due to the proposed project will range between 0 dB Ldn and 0.2 dB Ldn.

Table 13 Predicted Cumulative (Year 2020) Traffic Noise Level Data				
			Distance to Traffic Noise Contours (ft.)	
Segment	Description	Ldn, dB @ 100’	60 dB	65 dB
Hwy 49				
1	South of Kemper Road	72.3	662	307
2	North of Luther Road	72.3	662	307
3	South of Luther Road	71.9	617	286
Luther Road				
4	State Route 49 to Canal Street	61.2	120	56
5	Canal Street to Wesley Lane	60.6	110	51
6	East of Wesley Lane	60.6	109	51
Canal Street				
7	North of Luther Road	51.5	27	13

Table 14 Predicted Cumulative (Year 2020) + Project Traffic Noise Level Data					
				Distances to Traffic Noise Contours (ft.)	
Segment	Description	Ldn , dB @ 100’	Increase in Noise Levels, dB	60 dB	65 dB
State Route 49					
1	South of Kemper Road	72.5	0.2	678	315
2	North of Luther Road	72.5	0.2	678	315
3	South of Luther Road	72.0	0.1	630	292
Luther Road					
4	State Route 49 to Canal Street	61.3	0.1	123	57
5	Canal Street to Wesley Lane	60.8	0.2	113	52
6	East of Wesley Lane	60.7	0.1	112	52
Canal Street					
7	North of Luther Road	51.5	0	27	13

Future Commercial Use Noise

There are a variety of noise sources associated with the proposed development that have the potential to create noise levels in excess of the applicable noise standards or result in annoyance at existing and future noise-sensitive developments within the project area. Such uses/noise sources include, but are not limited to, commercial loading docks, parking lot noise, roof-top air handling equipment, and on-site truck circulation.

As a means of determining future noise levels associated with potential and proposed commercial uses on the site, noise monitoring data and standard modeling techniques were used.

Truck Passages and Loading Dock Activities

Loading docks are likely to be used in commercial areas. Due to the elevated noise emissions of heavy trucks and the common practice of using loading docks during late night or early morning hours, adverse public reaction to loading dock usage is not uncommon. This is especially true if heavy trucks idle during unloading or if refrigeration trucks are parked in close proximity to residential boundaries.

Based upon the size of the proposed commercial uses, it was assumed that truck deliveries will consist of approximately 4 to 6 semi-trailer trucks per week, and 2 trucks per day (generally no more than one per hour) for delivery of materials to the loading dock.

Bollard & Brennan, Inc. has collected noise level data for individual truck arrival, unloading, and departure for a loading dock. Typical noise levels at a reference distance of 50 feet are 87 dB SEL and 80 dB Lmax.

Based upon the overall noise levels due to truck passbys and loading dock operations, the noise level data and operational data described above, the hourly Leq and Ldn values can be determined using the following formulas:

$$Leq = 87 + 10 * (\log Neq) - 35.6, dB:$$

$$Ldn = 87 + 10 * (\log Neq) – 49.4, dB:$$

For determining the Leq, the mean sound exposure level (SEL) for a truck arrival and departure, is 87 dB and 10 * (log N_{eq}) is 10 times the logarithm of the number of truck arrivals and departures during an hour, and 35.6 is 10 times the logarithm of the number seconds in an hour.

For determining the daily Ldn, the mean sound exposure level (SEL) for a truck arrival and departure, is 87 dB and 10 * (log N_{eq}) is 10 times the logarithm of the number of equivalent truck arrivals and departures during a 24-hour period (this assumes that any truck arrival and departure during the early morning period before 7:00 a.m. will be factored by 10 times), and 49.4 is 10 times the logarithm of the number seconds in a day.

Based upon the above formula, the worst case hour of truck activity would result in average noise levels of approximately 52 dB Leq at a reference distance of 50 feet. The 24-hour Ldn is calculated to be approximately 50.6 dB, while assuming that both of the truck deliveries will occur before 7:00 a.m. (during the nighttime hours). The nearest noise-sensitive uses to the proposed circulation route are the existing residential uses located approximately 800 feet to the north of the site.

Therefore, hourly noise levels generated by truck passages and loading dock activities are predicted to be approximately 28 dB Leq and 56 dB Lmax, at the nearest residences. Truck passage and loading dock noise levels would result in an Ldn of approximately 27 dB at the nearest residences. It should be noted that the project site is shielded from the nearest residences due to intervening topography, therefore, predicted noise levels could be considered conservative.

Air Handling Equipment

Generally air handling equipment within a business park will be limited to roof-top HVAC (Heating Ventilation and Air Conditioning) systems. Noise levels due to HVAC systems can vary based upon the number of units used for cooling (Five 5-ton HVAC units will generally produce more noise than one 25-ton unit), orientation of openings, type of fan, and the presence of sound suppression equipment such as acoustical hoods or silencers.

As a means of determining an estimate of noise levels due to HVAC systems, it can be assumed that for every 30-tons of cooling capacity an A-weighted sound power level of 97 dB is produced. However, the use of plenum fans have been found to reduce overall noise levels due to HVAC units by up to 15 dBA. Assuming an A-weighted sound power level of 97 dB, the distance to the daytime 50 dB L_{eq} noise level criterion is 225 feet. The distance to the nighttime 45 dB L_{eq} noise level criterion is 400 feet.

However, it should be noted that shielding from the edge of the roof top, and the inclusion of parapets will generally reduce overall noise levels. In addition, orienting fan openings away from residential areas, and including plenum fans will further reduce the potential for annoyance.

Parking Lot Activities

Parking lot noise typically includes periods of conversation, doors slamming, engines starting and stopping and vehicle passages. Bollard & Brennan, Inc. file data for parking lot activities was used to model the parking lot noise environment at the nearest noise sensitive use.

An average sound exposure level (SEL) of 65 dB at a distance of 100 feet was used to represent parking lot arrivals and departures. The traffic study for this project indicates that the proposed project will generate 558 vehicular trips during the peak hour and a total of 6,134 daily trips.

Based upon the above-described noise level data, and the assumption that up to half of the peak hour vehicular trips could take place prior to 7:00 a.m. (during the nighttime hours), parking lot related noise levels were predicted at the nearest residences. Daytime and nighttime noise levels generated by parking lot activities were predicted to be approximately 39 dB Leq and 36 dB Leq, respectively, at the nearest residences located approximately 800 feet to the north of the project site. The parking lot noise levels would result in an Ldn of approximately 37 dB at the nearest residences. It should be noted that the project site is shielded from view of the nearest residences due to intervening topography, therefore, these parking lot noise levels could be considered conservative.

Construction Noise Levels

During the construction phases of the project, noise from construction activities would add to the noise environment in the immediate project vicinity. Activities involved in construction would generate maximum noise levels, as indicated in Table 15, ranging from 85 to 90 dB at a distance of 50 feet. Construction activities would be temporary in nature and normally occur during normal daytime working hours.

Noise would also be generated during the construction phase by increased construction-related traffic on local roadways. The intensity of this traffic will depend on how uses are under construction at any given time. A potentially significant project-generated noise source would be truck traffic associated with transport of heavy materials and equipment to and from construction sites. This noise increase would be of short duration, and would likely occur primarily during daytime hours.

Table 15
Construction Equipment Noise

Type of Equipment	Maximum Level, dB at 50 feet
Bulldozers	87
Heavy Trucks	88
Backhoe	85
Pneumatic Tools	85

Source: Environmental Noise Pollution, Patrick R. Cunniff, 1977.

MITIGATION MEASURES

Generalized Noise Mitigation Measures

Any noise problem may be considered as being composed of three basic elements: the noise source, a transmission path, and a receiver. The appropriate acoustical treatment for a given project should consider the nature of the noise source and the sensitivity of the receiver. The problem should be defined in terms of appropriate criteria (Ldn, Leq, or Lmax), the location of the sensitive receiver (inside or outside), and when the problem occurs (daytime or nighttime). Noise control techniques should then be selected to provide an acceptable noise environment for the receiving property while remaining consistent with local aesthetic standards and practical structural and economic limits. Fundamental noise control options include the following:

Use of Setbacks

Noise exposure may be reduced by increasing the distance between the noise source and receiving use. Setback areas can take the form of open space, frontage roads, recreational areas, storage yards, etc. The available noise attenuation from this technique is limited by the characteristics of the noise source, but is generally about 4 to 6 dB per doubling of distance from the source.

Use of Barriers

Shielding by barriers can be obtained by placing walls, berms or other structures, such as buildings, between the noise source and the receiver. The effectiveness of a barrier depends upon blocking line-of-sight between the source and receiver, and is improved with increasing the distance the sound must travel to pass over the barrier as compared to a straight line from source to receiver. The difference between the distance over a barrier and a straight line between source and receiver is called the "path length difference," and is the basis for calculating barrier noise reduction.

Barrier effectiveness depends upon the relative heights of the source, barrier and receiver. In general, barriers are most effective when placed close to either the receiver or the source. An intermediate barrier location yields a smaller path-length-difference for a given increase in barrier height than does a location closer to either source or receiver.

For maximum effectiveness, barriers must be continuous and relatively airtight along their length and height. To ensure that sound transmission through the barrier is insignificant, barrier mass should be about 4 lbs./square foot, although a lesser mass may be acceptable if the barrier material provides sufficient transmission loss. Satisfaction of the above criteria requires substantial and well-fitted barrier materials, placed to intercept line of sight to all significant noise sources. Earth, in the form of berms or the face of a depressed area, is also an effective barrier material.

Transparent noise barriers may be employed, and have the advantage of being aesthetically pleasing in some environments. Transparent barrier materials such as laminated glass and polycarbonate provide adequate transmission loss for most highway noise control applications. Transparent barrier materials may be flammable, and may be easily abraded. Some materials may lose transparency upon extended exposure to sunlight. Maintaining aesthetic values requires that transparent barriers be washed on a regular basis. These properties of transparent barrier materials require that the feasibility of their use be considered on a case-by-case basis.

The attenuation provided by a barrier depends upon the frequency content of the source. Generally, higher frequencies are attenuated (reduced) more readily than lower frequencies. This results because a given barrier height is relatively large compared to the shorter wavelengths of high frequency sounds, while relatively small compared to the longer wavelengths of the frequency sounds. The effective center frequency for traffic noise is usually considered to be 550 Hz. Railroad engines, cars and horns emit noise with differing frequency content, so the effectiveness of a barrier will vary for each of these sources. Frequency analyses are necessary to properly calculate barrier effectiveness for noise from sources other than highway traffic.

There are practical limits to the noise reduction provided by barriers. For highway traffic noise, a 5 to 10 dB noise reduction may often be reasonably attained. A 15 dB noise reduction is sometimes possible, but a 20 dB noise reduction is extremely difficult to achieve. Barriers usually are provided in the form of walls, berms, or berm/wall combinations. The use of an earth berm in lieu of a solid wall may provide up to 3 dB additional attenuation over that attained by a solid wall alone, due to the absorption provided by the earth. Berm/wall combinations offer slightly better acoustical performance than solid walls, and are often preferred for aesthetic reasons.

Site Design

Buildings can be placed on a project site to shield other structures or areas, to remove them from noise-impacted areas, and to prevent an increase in noise level caused by reflections. The use of one building to shield another can significantly reduce overall project noise control costs, particularly if the shielding structure is insensitive to noise. As an example, carports or garages can be used to form or complement a barrier shielding adjacent dwellings or an outdoor activity area. Similarly, one residential unit can be placed to shield another so that noise reduction measures are needed for only the building closest to the noise source. Placement of outdoor activity areas within the shielded portion of a building complex, such as a central courtyard, can be an effective method of providing a quiet retreat in an otherwise noisy environment. Patios or balconies should be placed on the side of a building opposite the noise source, and "wing walls" can be added to buildings or patios to help shield sensitive uses.

Building Design

When structures have been located to provide maximum noise reduction by barriers or site design, noise reduction measures may still be required to achieve an acceptable interior noise environment. The cost of such measures may be reduced by placement of interior dwelling unit features. For example, bedrooms, living rooms, family rooms and other noise-sensitive portions of a dwelling can be located on the side of the unit farthest from the noise source.

Bathrooms, closets, stairwells and food preparation areas are relatively insensitive to exterior noise sources, and can be placed on the noisy side of a unit. When such techniques are employed, noise reduction requirements for the building facade can be significantly reduced, although the architect must take care to isolate the noise impacted areas by the use of partitions or doors.

In some cases, external building facades can influence reflected noise levels affecting adjacent buildings. This is primarily a problem where high-rise buildings are proposed, and the effect is most evident in urban areas, where an "urban canyon" may be created.

Bell-shaped or irregular building facades and attention to the orientation of the building can reduce this effect.

Noise Reduction by Building Facades

When interior noise levels are of concern in a noisy environment, noise reduction may be obtained through acoustical design of building facades. Standard commercial construction practices provide 10-15 dB noise reduction for building facades with open windows, and approximately 25 dB noise reduction when windows are closed. Thus a 25 dB exterior-to-interior noise reduction can be obtained by the requirement that building design include adequate ventilation systems, allowing windows on a noise-impacted facade to remain closed under any weather condition.

Where greater noise reduction is required, acoustical treatment of the building facade is necessary. Reduction of relative window area is the most effective control technique, followed by providing acoustical glazing (thicker glass or increased air space between panes) in low air infiltration rate frames, use of fixed (non-movable) acoustical glazing or the elimination of windows. Noise transmitted through walls can be reduced by increasing wall mass (using stucco or brick in lieu of wood siding), isolating wall members by the use of double- or staggered- stud walls, or mounting interior walls on resilient channels. Noise control for exterior doorways is provided by reducing door area, using solid-core doors, and by acoustically sealing door perimeters with suitable gaskets. Roof treatments may include the use of plywood sheathing under roofing materials.

Whichever noise control techniques are employed, it is essential that attention be given to installation of weatherstripping and caulking of joints. Openings for attic or sub-floor ventilation may also require acoustical treatment; tight-fitting fireplace dampers and glass doors may be needed in aircraft noise-impacted areas.

Design of acoustical treatment for building facades should be based upon analysis of the level and frequency content of the noise source. The transmission loss of each building component should be defined, and the composite noise reduction for the complete facade calculated, accounting for absorption in the receiving room. A one-third octave band analysis is a definitive method of calculating the A-weighted noise reduction of a facade.

Use of Vegetation

Trees and other vegetation are often thought to provide significant noise attenuation. However, approximately 100 feet of dense foliage (so that no visual path extends through the foliage) is required to achieve a 5 dB attenuation of traffic noise. Thus the use of vegetation as a noise barrier should not be considered a practical method of noise control unless large tracts of dense foliage are part of the existing landscape.

Vegetation can be used to acoustically "soften" intervening ground between a noise source and receiver, increasing ground absorption of sound and thus increasing the attenuation of sound with distance. Planting of trees and shrubs is also of aesthetic and psychological value, and may reduce adverse public reaction to a noise source by removing the source from view, even though noise levels will be largely unaffected. It should be noted, however, that trees planted on the top of a noise control berm can actually slightly degrade the acoustical performance of the barrier. This effect can occur when high frequency sounds are diffracted (bent) by foliage and directed downward over a barrier. In summary, the effects of vegetation upon noise transmission are minor, and are primarily limited to increased absorption of high frequency sounds and to reducing adverse public reaction to the noise by providing aesthetic benefits.

Specific Noise Impacts and Mitigation Measures

<u>Traffic Noise Impacts</u>

Impact 1: Development within the project area will generate increased traffic on the local roadway system. Existing plus project-generated traffic is expected to result in traffic noise level increases over the existing no project condition ranging from approximately 0 dB Ldn to 0.3 dB Ldn at a representative distance of 100 feet from the roadway centerline. Based upon Table 6, this increase in traffic noise levels along the local roadway network would be imperceptible, therefore, this impact is considered to be **less than significant**.

Mitigation for Impact 1: None Required.

Impact 2: Development within the project area will generate increased traffic on the local roadway system. This project-generated traffic is expected to result in traffic noise level increases over Interm (2010) no project noise levels ranging from approximately 0 dB Ldn to 0.2 dB Ldn at a distance to 100 feet from the roadway centerline. This increase in traffic noise levels along the local roadway network would be imperceptible, and is therefore considered to be **less than significant**.

Mitigation for Impact 2: None Required.

Impact 3: Development within the project area will generate increased traffic on the local roadway system. This project-generated traffic is expected to result in traffic noise level increases over Cumulative (2020) no project noise levels ranging from approximately 0 dB Ldn to 0.2 dB Ldn at a distance to 100 feet from the roadway centerline. Based upon Table 6, this increase in traffic noise levels along the local roadway network would be imperceptible, therefore, this impact is considered to be **less than significant**.

Mitigation for Impact 3: None Required.

Impact 4: Due to the proximity of Highway 49 to the project site, traffic on this roadway could potentially generate noise levels that would exceed the interior noise level standards for offices spaces within the proposed office buildings. To judge the potential of achieving compliance with the applicable standards, it is necessary to determine the noise reduction provided by the building facade. This may be calculated by assuming a generalized A-weighted noise frequency spectrum for traffic noise. The composite transmission loss and resulting noise level in the receiving room must be determined, then correcting for room absorption, the overall noise level in the room is calculated.

A building facade noise level reduction analysis was previously performed by Bollard and Brennan, Inc. for one of the proposed buildings located nearest to Highway 49 (The Plaza, Placer County, California, August 2002). The conclusion of this analysis indicates that future interior noise levels could exceed the applicable interior noise level criteria at second floor office buildings. Therefore, this impact is considered **significant.**

Mitigation for Impact 4: None Required.

The recommendations contained within the previously prepared analysis should be incorporated into the project design. Specifically, windows of upper floor offices, facing Highway 49, should have a Sound Transmission Classification (STC) rating of at least 30.

Parking Lot Activity

Impact 5: The development of the project site includes the creation of approximately 424 parking spaces. Noise generated by parking lot activities could potentially affect the nearest noise sensitive uses.

An average sound exposure level (SEL) of 65 dB at a distance of 100 feet was used to represent parking lot arrivals and departures. The traffic study for this project indicates that the proposed project will generate 558 vehicular trips during the peak hour and a total of 6,134 daily trips.

Based upon the above-described noise level data, and the assumption that up to half of the peak hour vehicular trips could take place prior to 7:00 a.m. (during the nighttime hours), parking lot related noise levels were predicted at the nearest residences. Daytime and nighttime noise levels generated by parking lot activities were predicted to be approximately 39 dB Leq and 36 dB Leq, respectively, at the nearest residences located approximately 800 feet to the north of the project site. Furthermore, these parking lot noise levels would result in an Ldn of approximately 37 dB at the nearest residences. These noise levels would not exceed the Auburn Bowman Community Plan 45 dB Leq nighttime noise level standard or the Placer County 50 dB Ldn exterior noise level standard. Therefore, this impact would be considered **less than significant.**

Mitigation for Impact 5: None Required.

Air Handling Equipment

Impact 6: Development of the proposed commercial uses would include the use of rooftop HVAC equipment in order to maintain comfortable temperatures within these buildings. Noise generated by these units could potentially affect noise levels at the nearest noise sensitive use. Based upon an Leq of 50 dB at a distance of 225 from this roof-top equipment, unshielded HVAC noise levels at the nearest residential property line are predicted to be approximately 39 dB Leq or 46 dB Ldn. These noise levels would not exceed the Auburn Bowman Community Plan 45 dB Leq nighttime noise level standard or the Placer County 50 dB Ldn exterior noise level standard. Therefore, this impact would be considered **less than significant.**

Mitigation for Impact 6: None Required.

<u>Construction Noise Impacts</u>

Impact 7: Activities involved in construction would typically generate maximum noise levels ranging from 85 to 90 dB at a distance of 50 feet. Due the relatively small distance between the existing noise-sensitive uses and the uses proposed, construction will result in periods of significant ambient noise level increases. Because construction activities could result in periods of elevated noise levels at existing residences, this impact is considered potentially **significant**.

Mitigation for Impact 7:

Construction activities should be restricted to the daytime hours of operation, when possible. All equipment should be fitted with factory equipped mufflers and in good working order. Implementation of the noise mitigation measures would reduce this impact to be considered **less than significant.**

Appendix A
Acoustic Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, defined as one-tenth of the logarithm of the ratio of the sound pressure squared over the reference pressure squared.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.
Ldn	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
Loudness	A subjective term for the sensation of the magnitude of sound.
L(n)	The sound level exceeded a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one hour period.
Noise	Unwanted sound.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.
RT_{60}	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches